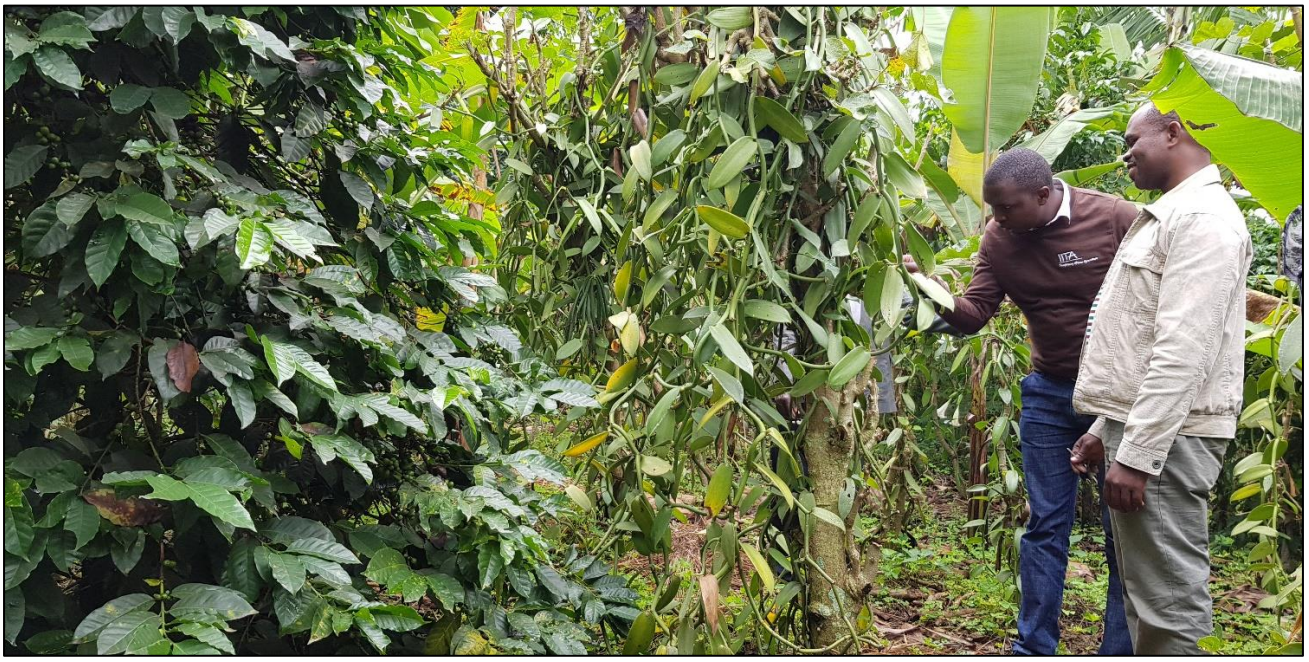
Coffee and Vanilla Diversification Project Report



Coffee and Vanilla Diversified Systems in Uganda:

Exploring effective approaches

for resilient coffee and vanilla farming systems

2019

A study conducted by: International Institute of Tropical Agriculture in Uganda

With support from Sustainable Food Lab
In collaboration with Catholic Relief Services

Acronyms and Abbreviations

ARC	Alliance for Resilient Coffee
CRS	Catholic Relief Services
CC	Climate Change
CSA	Climate Smart Agriculture
FGD	Focus Group Discussion
GAPS	Good Agricultural Practices
HH	Household
IITA	International Institute of Tropical Agriculture
Kg	kilogram
MAAIF	Ministry of Agriculture, Animal Industry, and Fisheries
NAADS	National Agriculture Advisory Services
NaCORI	National Coffee Research Institute
NGO	Non-governmental organization
OWC	Operation Wealth Creation
RFCU	Rwenzori Farmers' Cooperative Union
SACCOS	Savings and Credit Cooperative Organizations
SFL	Sustainable Food Laboratory
UVAN	Uganda Vanilla Farmers' Network
VSLA	Village Savings and Loans Associations

Contents

Figures

Tables

Executive summary

Coffee and vanilla farming play an important economic and social role in the development of Uganda, the tenth largest coffee producer in the world and the second largest in East Africa after Ethiopia (UCDA 2015). Coffee is Uganda's leading agricultural export as between 4 and 5 million 60kg bags are exported. In 2018, 23,000 kg of cured vanilla worth USD6.40 million were exported. The production of the two crops is highly susceptible to the negative effects of climate change. A variety of initiatives by government and the private sector has been introduced to tackle challenges from climate change in coffee. However, the vanilla sector has not been prioritized by the government.

The International Institute of Tropical Agriculture (IITA) in collaboration with Catholic Relief Services (CRS) undertook a small project in Uganda to explore existing coffee and vanilla diversification. The study was funded by Sustainable Food Lab (SFL) on behalf of private sector partners interested in potential investment in vanilla production. The objective of the study was to provide recommendations on effective approaches for diversified farming systems in resilient coffee and vanilla.

A literature review was conducted of key publications and the knowledge existing on both coffee and vanilla growing and crop diversification. Subsequently, data collection tools and protocols were developed, and a baseline survey was conducted to gather information from smallholder farmers and other key stakeholders in the coffee and vanilla value chains in 2 districts, Kasese and Buikwe. The goal of the baseline was to document existing options for crop diversification among coffee and vanilla farmers working with CRS.

The baseline was conducted with farmers within the operational areas of CRS in Uganda. It covered 432 farming households from 7 sub-counties in Kasese and 6 sub-counties in Buikwe. A total of 216 smallholder farmers were interviewed from each district, collecting information from 16 focus group discussions (FGDs) and 2 stakeholders' workshops.

Results from the baseline show that the intercropping is the common farming system in the two districts (53%) followed by agroforestry (22%). The majority of the farmers interviewed in both districts have experienced climate shocks that have resulted in loss either of life or of crops and livestock. Coffee is the preferred crop in both districts based on reasons ranging from heritage to issues of security. Although vanilla provided the highest incomes to households, it is not very popular among the farmers as it is a more recent crop than coffee. The survey also found that smallholder farmers diversify crops mainly for providing household food and to boost income. However, a good number of them were seen to practice agroforestry for shade provision (a production requirement for both coffee and vanilla). The common CSA practices used in the 2 districts are mulching (27%), trenches (15%), crop rotation (10%), and cover crops (8%). Practices such as terracing were found to be 10% in Kasese while in Buikwe, 18% of farmers reported the use of compost manure. In Buikwe, the key stakeholders identified were the Uganda Vanilla Farmers Network (UVAN). In Kasese, stakeholders included farmer cooperatives such as the Rwenzori Farmers' Cooperative Union (RFCU). These stakeholders provide farmers with support such as agricultural extension, inputs, and credit services. Based on functional and structural indicators applied to farmers, 4 main farmer typologies were identified during the baseline.

The key findings of the survey and potential mitigation measures for challenges were presented and discussed with participating stakeholders in a validation workshop held in Kampala in February 2020. Key recommendations for private sector investment in further coffee and vanilla diversification are given at the end of this report.

The baseline results will serve as the basis for future interventions in the 2 districts.

1. Introduction and Background

The International Institute of Tropical Agriculture (IITA) has over time worked with smallholder coffee farmers to improve production and productivity in the eastern, central, and western parts of Uganda. In collaboration with public and private partners IITA developed the Stepwise approach that has been used to train farmers and give them management options for increased coffee production and resilience to the effects of climate change.

With support from the Sustainable Food Lab, IITA collaborated with CRS in a pilot study in 2 districts in Uganda producing coffee and vanilla. The intention was to provide recommendations for a proposal to the private sector on effective approaches for resilient coffee and vanilla farming systems, aimed at promoting intentional multi-commodity and food crop diversification among smallholder farmers. Preliminary knowledge was gathered on the current state of existing coffee and vanilla intercropping and recommendations were made.

2. Project Purpose

The goal of the project was to understand existing coffee and vanilla farming systems in order to provide recommendations on effective approaches for resilient farming systems for both crops.

The specific objectives were as follows. (1) Collect data on coffee and vanilla production underlining the cropping system, climate smart agriculture (CSA) practices applied by farmers, and the challenges farmers face in crop diversification. (2) Acquire information on best practices in diversification with which IITA, CRS, SFL and private sector partners can tailor future initiatives for resilient coffee and vanilla farming systems in Uganda.

More specifically, activities included the following.

1	**State-of-the-art coffee and vanilla diversification**
1.1	Review proposal draft, existing data from registration forms, and surveys from CRS, existing agronomic recommendations and scientific literature on coffee and vanilla growing (both at farm and plot level = intercropping), i.e., growing areas, production volumes, GAPs, cost efficiency, price developments, value chain actors for Uganda (and other countries, if necessary) as well as surveys conducted and data available of the cooperatives of interest.
2	**Develop data collection tools and conduct survey**
2.1	Based on 1.1, identification of knowledge gaps and creation of content for data collection tools.
2.2	Testing and adjustments of survey tools (in collaboration with CRS), planning field logistics and enumerator training.
2.3	Conduct of expert workshops and farmer household surveys in 2 study areas.
3	**Identify existing production systems and value chains, develop proposal**
3.1	Data cleaning, processing, and analysis of field data.
3.2	In cooperation with partners, development of proposal draft.
3.3	Development of information products (info note, blog).

3.0 Methodology

3.1 Literature Review

A literature review was conducted in July 2019 to explore publications in scientific journals and other key knowledge sources on the limitations and opportunities for vanilla production in Uganda and specifically, for coffee and vanilla diversified systems. The review concluded that diversification encourages smallholder inclusion in agricultural value chains at different scales towards higher-value crops and a gradual movement into the non-farm sector (Djurfeldt, 2018). Appropriate crop diversification strategies have delivered positive effects, and coffee farmers are expected to be motivated to diversify by growing industrial crops such as vanilla which may also mitigate market risk (Thong Ho, 2017). Crop diversification in synchronized systems has the potential to deliver agronomic and ecological benefits, depending on the characteristics of site-specific ecosystems. The literature review concluded that diversification of coffee and vanilla can provide farmers with

options for food and income security, and environmental and natural resource conservation which in the end result in resilience and adaptation to climate change.

4.2 Study Area

To verify the site-specific issues in Uganda, the study area was identified as Kasese district in western Uganda and Buikwe district in central Uganda, where CRS is already working with a network of coffee and vanilla farmers. Kasese district consists principally of 3 topographical features: (1) the mountainous areas, which consist of rugged mountain relief; (2) the undulating region at the foothills, and (3) the lowland flat areas in the south and south-eastern parts of the district. Kasese experiences a bimodal rainfall pattern (UBOS, 2017). The first rains are short but fall with high intensity during the March-May season, and the longer rains fall in the August-November season with a low intensity. Annual rainfall ranges from 800 to 1600 mm and is greatly influenced by altitude. Temperatures normally range between 23.9 and 30°C. Kasese is covered with varied vegetation types: stratified vegetation zones of grassland at between 1000 and 2000 m; montane forest at between 2000 and 3,000 m; the bamboo/mimulopsis zone at 2500 to 3,000 m; the heather/rapanea zone at 3,000 to 4000m; and an Afro-Alpine zone at 4,000 to 5,000 m (UBOS, 2017). The main land use types in the district are crop farming, livestock keeping, fishing, mining, forestry reserves, and national parks.

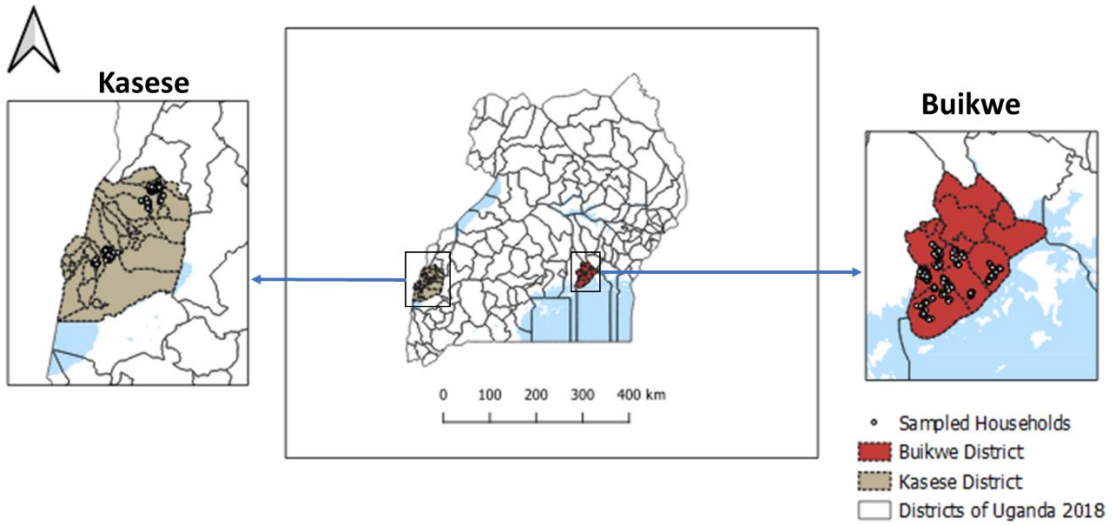


Figure 1: Map of Uganda showing study sites.

Buikwe district is one of the central districts, originally part of Mukono district. The district has a total area of about 1,209 km^2. The mean annual rainfall is 11,000 mm distributed over 106 rain days with peaks in March - May and September - November. Temperatures range between 16 °C and 28 °C throughout the year. Generally, the vegetation cover is forest/savanna mosaic characterized by patches of dense forest (Mabira) in the south and scattered trees in shrub and grassland of the north (Buikwe district, 2015; UBOS, 2017). The district also has a distribution of wetland vegetation of different species in addition to swamp forest tree species (Buikwe district, 2016; UBOS, 2017). Manufacturing is a big source of employment in Buikwe. Firms such as the Sugar Corp. of Uganda Ltd. Ugma Engineering Corp. Ltd, Cable Corp. Ltd, Uganda Hortech Ltd, Southern Range Nyanza Textiles, Nile Breweries Ltd, Uganda Tea Corp., and GM Sugar Ltd are all located in Buikwe (UBOS, 2017). The land use is mainly cropping, livestock, forests, rocks, swamps, lakes, and rivers.

4.3 Sampling Procedure

RFCU and the district local government in Buikwe provided lists of coffee and vanilla producers from the different sub-counties. The respondents who participated in the baseline survey were randomly selected from these lists. A multistage sampling procedure was adopted. This first involved purposive sampling to identify farmers growing coffee and vanilla. Proportionate sampling was then done at sub-county level to identify the number of farmers per sub-county for interviews. Thereafter simple random sampling was done to identify respondents. The randomization was done using R statistical software version 3.6.2, to obtain a proportionate sample number of respondents from each sub-county. Extension staff in the field then contacted Lead farmers

by telephone, who in turn contacted selected farmers to inform them of their scheduled interview day. The randomized names of farmers were then given to the enumerators to proceed to the field. A total of 432 households were selected as outlined in Table 1.

Table 1: Number of Households Interviewed per sub-county.

Buikwe district			Kasese district	
Sub-county	No. of households		Sub-county	No. of households
Ssi	49		Buhuhira	63
Ngogwe	39		Kisinga	23
Najja	32		Kyondo Kisinga	47
Buikwe	53		Kyarumba	30
Nkokonjeru	31		Maliba	27
Kawolo	12		Kitswamba	07
			Kyabarungira	19
Total	**216**		**Total**	**216**

4.4 Data Collection

The baseline survey used a mixed approach of qualitative and quantitative data collection for complementary data collection (Burke and Johnson,2005). The survey was conducted using digitalized questionnaires on tablets, and the data were uploaded online by data collectors while in the field. The qualitative data collection involved stakeholders' workshops and focus group discussions (FGDs). The workshops were conducted in both districts with key stakeholders in the coffee and vanilla value chains to focus on the land use and value chain mapping. The FGDs were conducted with the coffee and vanilla farmers at sub-county level. The purpose of the FGDs was to segment or cluster farmers, based on their different characteristics, to understand the CSA practices adopted by different farmers in the area. Focus groups were designed to have between 7 and 12 participants. The groups were separated by gender such that discussions were held independently between males and females. The quantitative data collection used individual interviews for farmers at household level. The digitized questionnaire was semi-structured with both open-ended and close-ended questions. Enumerators were selected and trained on the use of the digitalized questionnaire. Pretesting of the questionnaire was done with farmers from Luwayo Village in Kawolo sub-county. The latter did not participate in the survey. Data were collected in 2019 from 14 to 23 October in Kasese and from 28 October to 7 November in Buikwe. A total of 432 respondents were interviewed, 216 from each district – as above.

4.5 Data Analysis

Quantitative data were processed, analyzed, and organized in tables using R 3.6.2 and Microsoft Excel. Descriptive statistical values including frequency counts, percentages, minimum and maximum values, plus, averages were calculated to explain general household characteristics. Qualitative information was used to provide in-depth description of each output and analysis to complement the quantitative data. To obtain the typologies of farmers from the quantitative data a multivariate approach was used. Data were reduced to check for correlation among variables. Using a hierarchical clustering approach for mixed data, the farmer segments were created.

5 Results

5.1 General Household Characteristics

The farmers in the baseline study were mainly men (75.9%) in both districts. This could be an indication that both coffee and vanilla are male dominated crops. Most men in both districts are above 40 years of age and have an average household size of 8 individuals, including 4 children. Most respondents are married: 91.2% in Kasese and 89.8% in Buikwe. Decision-making in each of the households visited is mainly done by the husband, although a good number of respondents indicated that they make decisions with their spouses. However, the wives do not make independent decisions. The respondents have differing levels of formal education with 57.6% having attained primary education; 26.2% have secondary education with very few having tertiary-level training. The main source of income is farming for 94.1% of respondents, followed by trading at 56.3% across both districts. Other income sources identified included formal employment and riding commercial motorcycles also known as *boda-boda*. In terms of experience, the farmers had more experience in coffee

production (average 17 years) than in vanilla production (average 6.5 years). Most households visited subscribed to at least one group and had reasonable access to extension services, mainly from RFCU and UVAN. Few respondents had access to district extension staff for information on vanilla and for related extension services in particular. The majority indicated that the extension staff do not know where they stay. Some of the farmers have obtained credit from various credit institutions in the last one year. The farmers in Kasese are physically closer to input and output markets (only 3-4 km distance) than the farmers in Buikwe who are 15-17 km away. However, due to the topography, farmers in Kasese have more difficulties in accessing input and output markets. When it comes to climate change, a good percentage of the farmers reported that they have experienced climate change shocks. Those shocks mentioned in Kasese included rivers flooding, and landslides while prolonged drought and torrential rains were commonly identified in Buikwe.

Household characteristics are summarised in the tables below:

Table 2a: Household characteristics for Kasese and Buikwe districts.

	Proportion of households (%)	
Variables (categorical)	Kasese	Buikwe
Gender		
Male	75.5	76.4
Female	24.5	23.6
Marital status		
Single	3.7	3.2
Married	91.2	89.8
Separated	1.4	3.7
Widowed	3.7	3.2
Education		
None	7.9	11.6
Primary	61.1	54.2
Secondary	24.5	27.8
Tertiary	6.5	6.5
Source of income		
Primary source of income (Farming)	94.4	94.9
Secondary source of income (Trading)	57.8	57.9
HH decision-maker		
Both husband and wife	44.9	34.7
Husband	46.8	57.4
Wife	5.6	5.6
Family	2.8	2.3
Access to credit	44	56.9
Climate change shock experience	74	63

Source: Survey data 2019.

Table 2b: Household characteristics for Kasese and Buikwe districts.

Continuous variables	Kasese				Buikwe				Overall			
	Mean	Se	Min	Max	Mean	Se	Min	Max	Mean	Se	Min	Max
Age (yrs)	48.8	0.94	21	85	42.6	10.7	22	69	47.26	0.65	19	87
No of Children	4.77	0.16	0	15	6.1	2.1	3	10	4.7	0.12	0	15
Household size	8.93	0.23	2	20	9.3	2.7	5	14	8.28	0.17	2	21
Primary income ('000 UGX)	3,954	373	200	50,000	10,800	13,600	400	50,000	4,042	262	200	50,000
Secondary Income ('000 UGX)	947	149	0	20,000	6,406	8,085	0	30,000	1,170	132	0	30,000
Vanilla farming experience (yrs)	5.86	0.38	0.2	26	5.6	4.7	0.5	19	0.67	0.03	0.1	3
Coffee farming experience (yrs)	18.82	0.92	0.5	60	13.2	10.9	0.5	40	1.2	0.07	0.125	19
Area of vanilla production (ac)	0.77	0.04	0.1	3	1.1	0.8	0.25	3	2.47	0.3	0	100
Area of coffee production (ac)	1.28	0.11	0.125	19	2	2.6	0.25	11.5	6.47	0.29	0.2	30
Distance to nearest input market (km)	4.23	0.42	0.1	50	15.6	17.7	0.5	60	1.32	0.08	0.5	15
Distance to nearest output market (km)	3.45	0.25	0.1	21	17	18.9	0.1	60	4.49	0.33	0.04	60
Distance to the nearest Agric. Offices (km)	4.83	0.33	0.1	25	11.1	8.5	1	30	3.53	0.29	0.1	60
Duration in the group (yrs)	6.27	0.36	0.5	20	3.5	5.3	0.5	20	4.26	0.25	0.5	30

Source: Survey data 2019.

5.2 Farmer Typologies

Using the indicators above, farmers in the 2 districts were segmented/clustered. Four significant farmer categories emerged from Tables 2b and 3. In Kasese district, the farmers in segment IV are older - over 55 years. Those in segment III are young, on average about 31 years of age. Those in segments I and II are mature, about 46 to 48 years of age. Older farmers have more income than all the other categories. The discussions within the FGDs highlighted the fact that most respondents are landowners who have more assets and can access loans to boost their income. From the FGDs, most young farmers inherited land from their parents although some bought the land on which production is carried out. Young farmers have a dependency burden of about 10 members per household (almost like those from households of the older farmers which showed 11 members each). Compared to the older farmers young farmers have a considerable area under coffee and vanilla production. Their experience in production of these crops does not differ much from that of the mature farmers. They are closer to the output and input markets and the agricultural offices. In comparison with the other categories they have better access to services that would support their activities and enhance their production. In addition, most of them have gone to school and attained at least secondary education, a factor that is crucial in their income acquisition and financial management.

In Buikwe district, the farmers were between 40 and 50 years of age (segments I, II, III, and IV). The older farmers have the highest dependency burden (14 members) compared to all the others. The 43-year category had the most income from both primary and secondary sources, and the largest land area under coffee and vanilla production. The 47-year old category had more experience in coffee and vanilla production followed by the 41-year old category. In terms of proximity to services, most farmers in Buikwe are near main roads, an indication that they have easier access to markets and extension services than Kasese farmers. The young people in Buikwe are not interested in perennial crops such as vanilla because of the time they take to mature. They prefer to engage in annual crops such as rice and vegetables that give quick cash. However, for extra income, they also offer labor to the older farmers growing coffee and vanilla and are employed in the many factories in the district.

Table 3: Categories of farmers in Kasese and Buikwe districts.

Kasese district farmer segments

Variable	Segment I (n=47)		Segment II (n=97)		Segment III (n=12)		Segment IV (n=62)	
	Mean	s.e	Mean	s.e	Mean	s.e	Mean	s.e
Age	45.55	1.87	47.92	1.43	31.58	2.99	55.94	1.29
No of children	4.51	0.34	4.42	0.2	4	0.63	5.66	0.36
Total No of people in the household	8.7	0.58	7.92	0.28	9.75	1.09	10.48	0.43
Primary income	2,295,745	317,016	2,556,211	265,100	2,241,667	437,877	7,683,590	1,073,951
Secondary income	892,340	293,514	765,537	226,405	541,667	217,234	1,345,355	312,552
Area of vanilla production	0.51	0.04	0.62	0.05	0.85	0.12	1.2	0.09
Area of coffee production	1.23	0.25	0.93	0.06	1.35	0.24	1.85	0.31
Years in vanilla production	3.21	0.44	3.55	0.36	2.96	0.61	11.98	0.7
Years in coffee production	18.03	1.93	15.99	1.26	14.25	2.74	24.62	1.86
Distance to main road	1.79	0.24	1.72	0.16	0.88	0.21	1.07	0.13
Distance to nearest input market	4.32	0.62	4.4	0.66	1.03	0.2	4.53	0.92
Distance to nearest output market	4.27	0.61	3.39	0.39	1.29	0.29	3.34	0.44
Distance to the nearest Agric. Offices	7.17	0.93	3.93	0.38	3.96	1.12	4.62	0.58
Duration in the group	5.93	0.74	4.55	0.41	5.5	1.44	9.32	0.74

Buikwe district farmer segments

Variables	Segment I (n=46)		Segment II (n=133)		Segment III (n=19)		Segment IV (n=18)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age	40.5	12.2	47.3	13.7	50.4	9.6	42.6	10.7
No of children	4.5	2	3.8	2	9.3	3.1	6.1	2.1
Total No of people in the household	7.4	2.7	6.6	2.9	13.9	3.6	9.3	2.7
Primary income	3323913	3596800	3395113	3069324	4915789	4735359	10800000	13600000
Secondary income	983043.5	1899656	1008083	1769347	340000	862270.9	6405556	8085170
Land size(vanilla(acres))	0.4	0.3	0.6	0.4	0.4	0.3	1.1	0.8
Land size(coffee (acres))	1	1.1	1	0.9	1.2	1.2	2	2.6
Exp. in coffee prod.(yrs)	16.2	11.6	17.3	13.2	9.2	8.7	13.2	10.9
Exp. in vanilla prod.(yrs)	6	5.9	8	7.1	4.4	4.3	5.6	4.7
Distance to nearest input market	5.1	8.8	3.2	2.7	4.8	4.7	15.6	17.7
Distance to nearest output market	2.7	3.2	2.4	4.1	1.9	2.5	17	18.9
Distance to the nearest Agric. Office	4.3	3.8	4.3	4	5	4.1	11.1	8.5
Duration in the group	3.4	6.2	1.9	3.6	0.6	1.3	3.5	5.3

Source: Survey data 2019.

5.3 Crop Diversification in the districts

5.3.1 Crop Production Systems

The two districts have mainly 4 crop production systems: (1) agroforestry, (2) intercropping, (3) sole cropping, and (4) sub-plots on the main plot area (Fig. 2). Intercropping was identified in 49% of households in Kasese and in 56% in Buikwe as the most practiced system, followed by agroforestry found in 26% of households in Kasese and 18% in Buikwe). Sole crops were mainly done for in maize, sugarcane, and rice grown for commercial purposes while the intercrops were mainly for subsistence crops. Agroforestry was practiced by farmers in the coffee and vanilla gardens because the two crops need a certain amount of shade in order to give good yields. Kasese district stands out in agroforestry as most farmers practice this deliberately to conserve the environment.

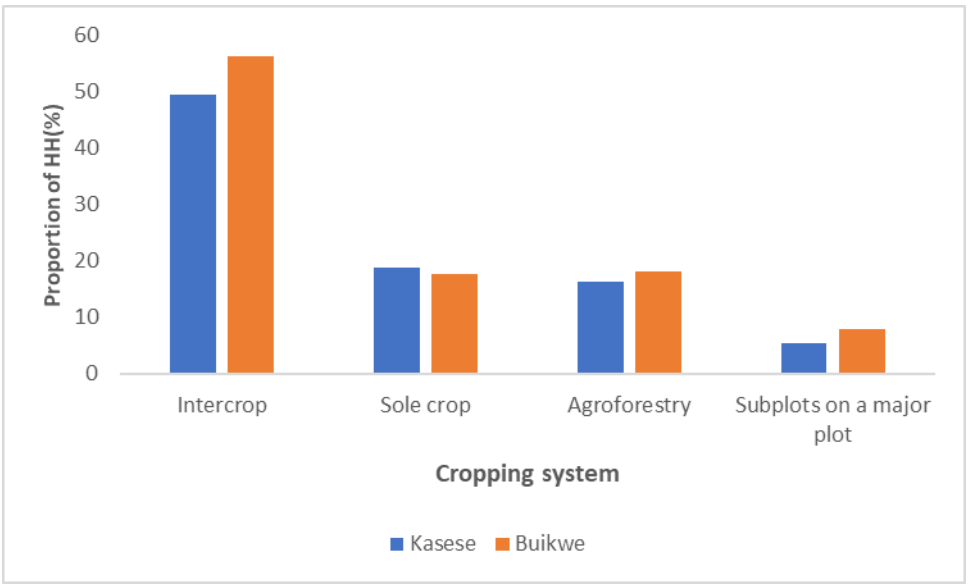


Figure 2: Crop production systems in Kasese and Buikwe districts.

5.3.2 Crops Grown

Various crops are grown in the different production systems. Figure 3 shows the priority crops in the 2 districts. Coffee and vanilla are most prioritized as cash crops across all respondents. Cocoa was the second prioritized cash crop, followed by sugarcane. There are more farmers engaged in cocoa production in Kasese than in Buikwe where more farmers are engaged in sugarcane production as out-growers for the sugar factories. Banana, cassava, beans, and maize are the most prioritized food crops for the two districts. Yam is another common crop in Buikwe that some vanilla farmers were growing for subsistence purposes.

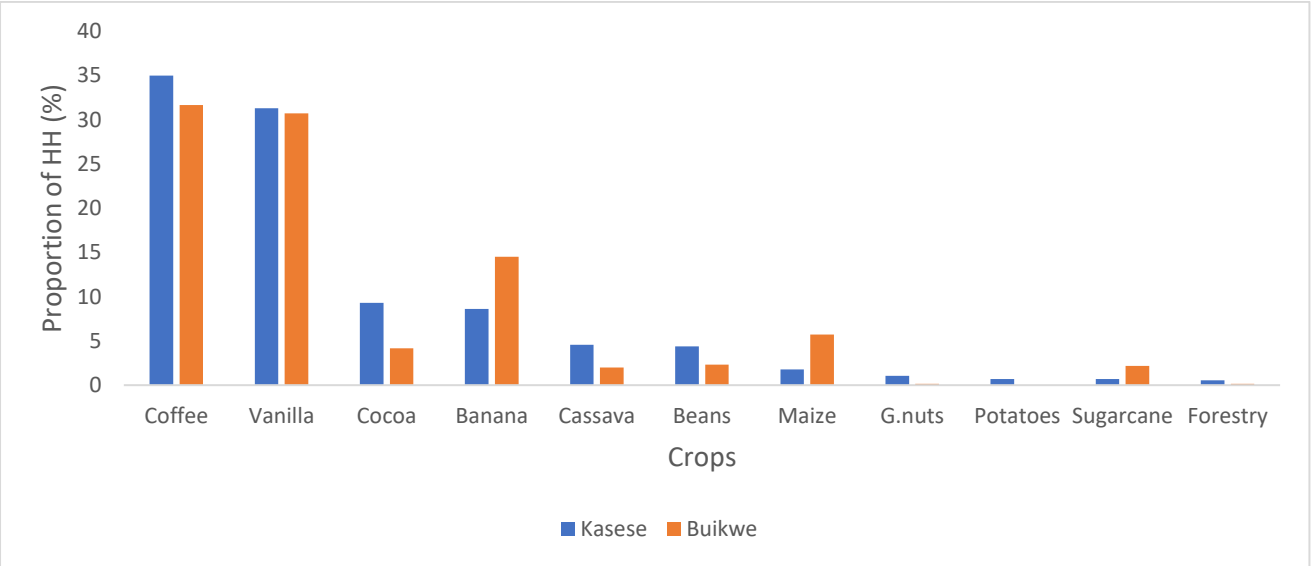


Figure 3: Priority cash and food crops in the districts.

5.3.3 Why Crop Diversification?

Farmers from both districts could not imagine life without diversification - an indication of the recognition of its importance. Every farmer identified with diversification as the means of survival. Figure 4 below shows the various reasons why farmers diversify their crops. According to respondents there are several reasons for diversification: food (21%) and income (25%) across both districts; and for shade provision - 20% in Buikwe and 18% in Kasese. Other reasons for diversification include increased production, risk management, and limited land so that farmers are forced to diversify. Most farmers have less than one hectare and therefore need to grow many crops on a small area to achieve levels of both household nutrition and income as depicted below. For the farmers that grow sugarcane, especially in Buikwe, diversification is the only way to get food for the household as sugarcane production depletes essential soil nutrients for the production of other crops.

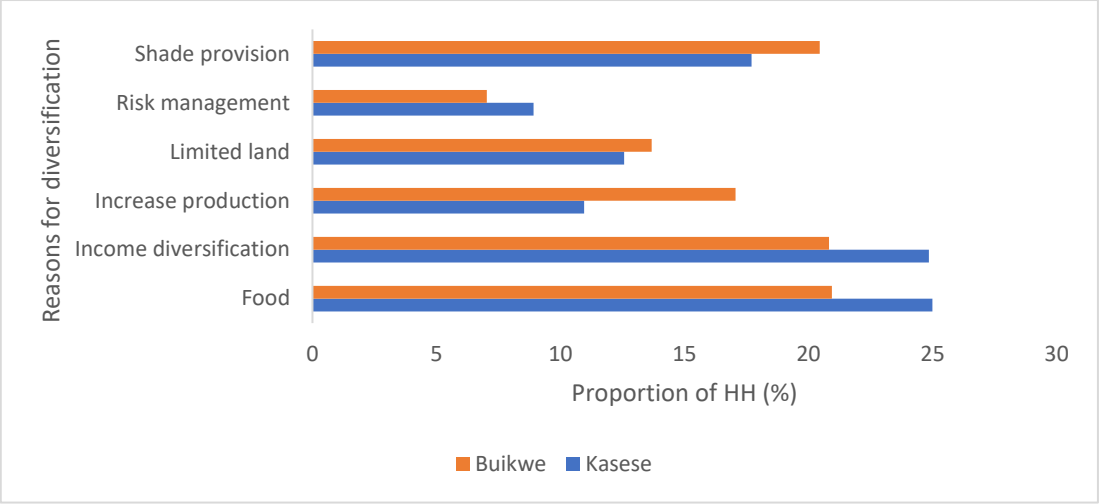


Figure 4: Reasons why farmers carry out crop diversification.

5.3.4 Challenges in diversification

Farmers in Kasese and Buikwe are faced with various challenges as indicated in Figure 5. The main challenge is from pests and diseases (49% of households in Buikwe and 42% in Kasese) followed by drought in both districts. Other challenges are limited capital and labor required for field management and provision of inputs. Intercropping might not be labor intensive as the requirements are shared among the crops but critical activities, e.g., vanilla pollination, can occur at the same time which then requires the hiring of additional labor. Some farmers (7% of households in Buikwe and 0.4% in Kasese) did not find any challenge in diversification.

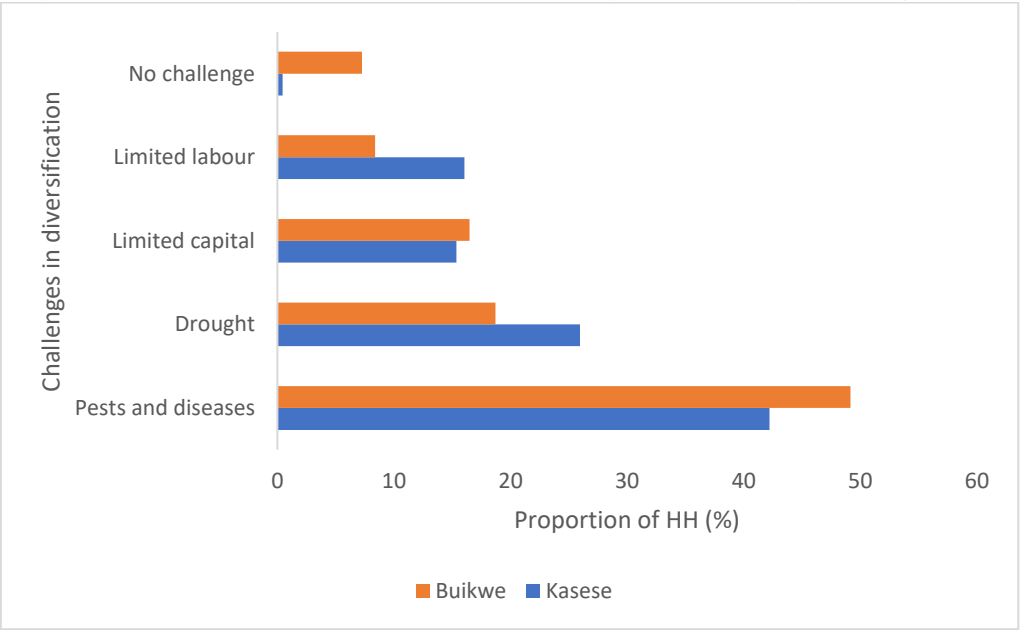


Figure 5: Bar graph showing challenges faced by farmers in the 2 districts in crop diversification.

5.3.5 Diversification Solutions

Farmers suggested solutions to challenges identified as shown in Figure 6 below. To overcome pests and diseases the farmers pointed to the use of pesticides although, at the time of the study, most of them were not using pesticides. To manage the problem of limited labor they suggested hiring labor from neighboring areas. To manage droughts the farmers suggested the use of irrigation and for limited labor, the farmers suggested working in groups and getting loans from microfinance institutions to be able to invest in their activities. Irrigation is suggested for both districts as they both have readily available sources of water in almost all sub-counties. This therefore makes the option of irrigation very appropriate.

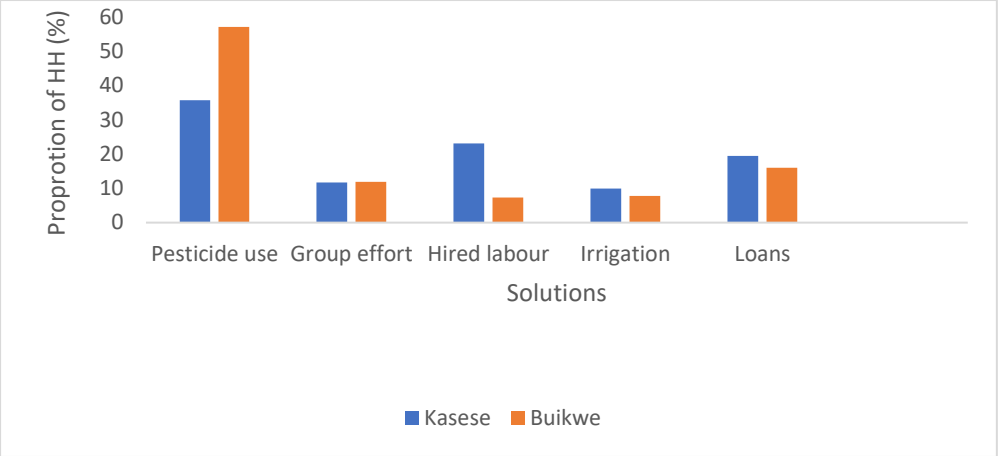


Figure 6: Suggested solutions to the challenges faced in diversification.

5.6 Investment in Coffee and Vanilla Production

5.6.1 Vanilla Investment -Time, Labor, and Finances

Overall, the production of vanilla is an intensive investment activity in terms of time, labor, and finances. Farmers in both districts invest a lot of time in it. Most do not hire labor for vanilla production for security reasons and rely on their own labor to curtail theft of their crop. This means that there is a high commitment on time and labor: time in Buikwe was 37% and in Kasese 47%, and labor in Buikwe 42% and Kasese 49% of time was recorded on vanilla production. Financial investment in vanilla production is for the 2 districts can be considered mixed as reported by 52% of households in Buikwe and 34% in Kasese. Farmers in Kasese do incur heavy expenses in guarding their crop from pollination to harvest while farmers in Buikwe have an arrangement with some of the actors such as UVAN who provide security and recover the costs when vanilla is sold after harvest. Most financial investments occur at the time of buying vines, putting up fences, and hiring security guards to protect the vanilla crop.

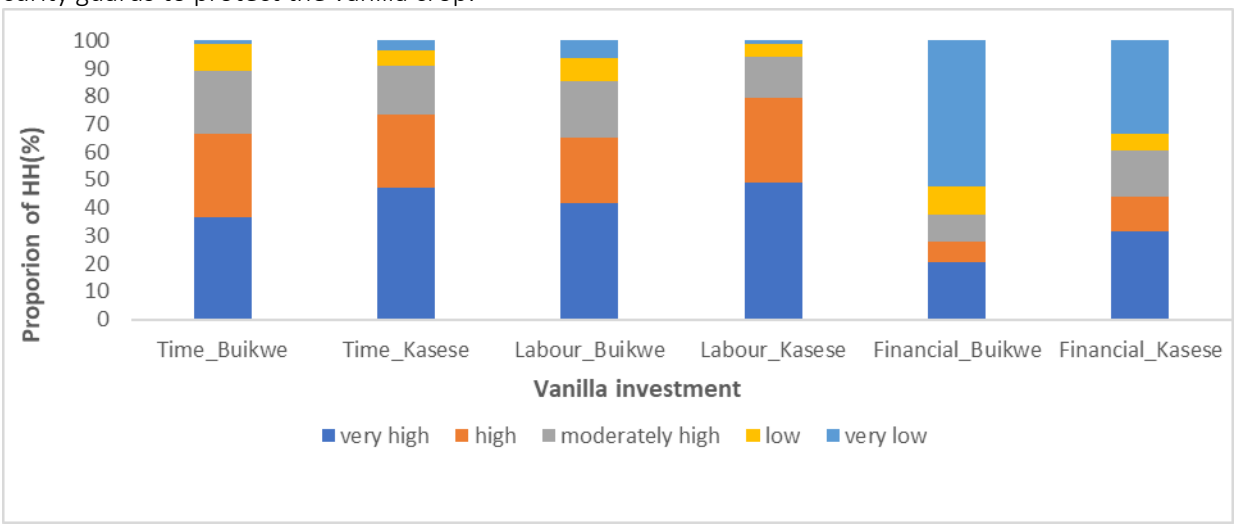


Figure 7: Bar graph showing level of time, labour and financial investment in vanilla production in the two districts.

5.6.2 Coffee investment - Time, Labor, and Finances

Generally, the investment in coffee production is not too heavy in terms of finances compared to vanilla: 69% for Buikwe and 58% for Kasese. Farmers in both districts reported investing relatively less money in coffee production. They also reported most of the work was done by family members. Also, coffee is a canopy-forming plant as well as being grown under shade and therefore tends to supress weeds which reduces the time and labor required for weeding. That said, a great deal of time and labor was recorded: Labor reported was 38% for households in Buikwe and 33.3% in Kasese, and time was reported as 33.5% in Buikwe and 41.3% in Kasese. These figures seem high since most farmers are dependent on family members for labor. Practices in coffee production include pruning, de-suckering, harvesting, and drying the coffee beans before, as shown (Fig. 8) below.

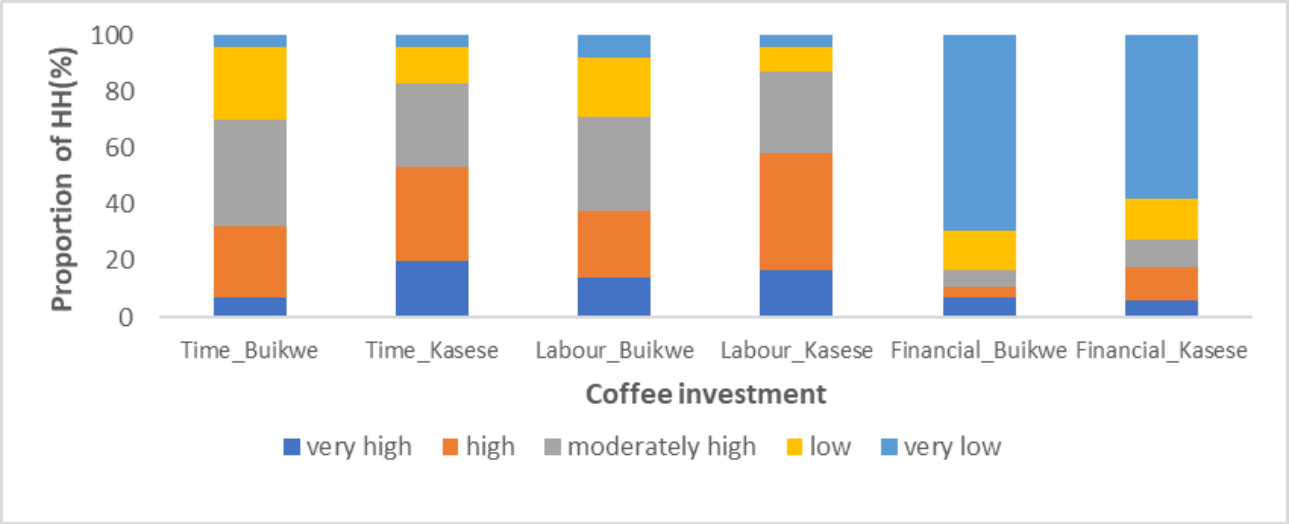


Figure 8:Bar graph showing level of time, labour and financial investment in coffee production in the two districts

5.7 Vanilla Investment - Agricultural Activities

The activities that take most of the farmers' time, labor, and finances were further analyzed. It was found that weeding (18% and 19%), pollination (19% and 22%), looping (15% and 23%) and guarding (15% and 13%) took the most time and labor for the farmers in Kasese and Buikwe districts respectively. Guarding, looping, pollination, and weeding have a high cost burden. Farmers in Kasese hire guards from private security agencies to police their gardens and buy dogs which they have to feed, contributing to the high cost of guarding. The farmers from Buikwe have guarding services paid by UVAN, the cost of which is offset against the purchase of vanilla by UVAN. As the farmers do not directly feel the cost of guarding, they cannot report on this. On the other hand, many farmers in Buikwe as well as in Kasese go on to guard themselves, spending sleepless nights. Weeding, pollination, and looping are the practices that take most of the farmers' labor, time, and financial resources during production.

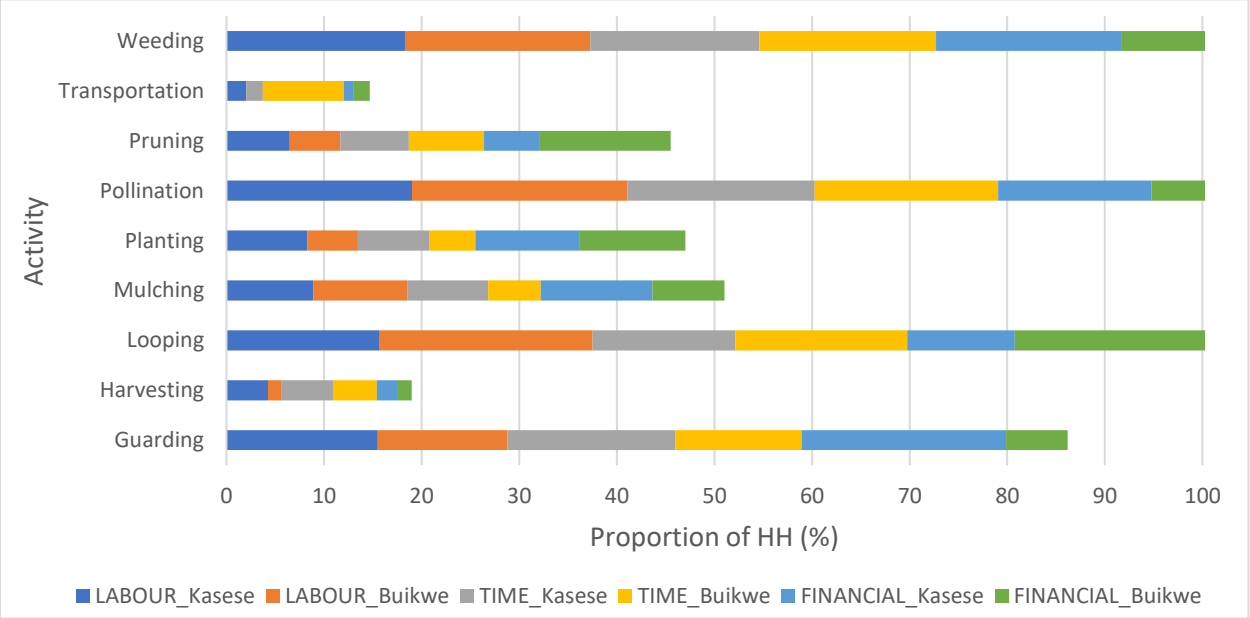


Figure 9 showing level of investment for each of the agricultural activities.

5.8 Income from vanilla vs other crops

Even though vanilla is a labor and time intensive crop, it is also highly rewarding in terms of its contribution to household income. The incomes received by all farmers were higher from vanilla than from any other crop. The box plot (Fig. 10) shows how incomes from the different crops are distributed. The lower tail shows the lower incomes received by 25% of the households; the box shows the incomes received by 50% of the households with the line indicating the median income; and the upper tail shows the highest incomes received by 25% of the remaining households in the study. Vanilla has the best distribution as most farmers earn

between UGX500,000 and UGX2,000,000 from their vanilla crop. The farmers in the lower and upper quartiles are very few in Kasese but there are more farmers in the upper than the lower quartile in Buikwe. The distribution of vanilla incomes for the farmers in the two districts is almost evenly distributed from low (UGX500,000) to high (UGX2,000,000) compared to those from cocoa and coffee. Farmers in Kasese also obtain income from forestry, unlike those from Buikwe that receive income instead from yam, tomato, and cabbage.

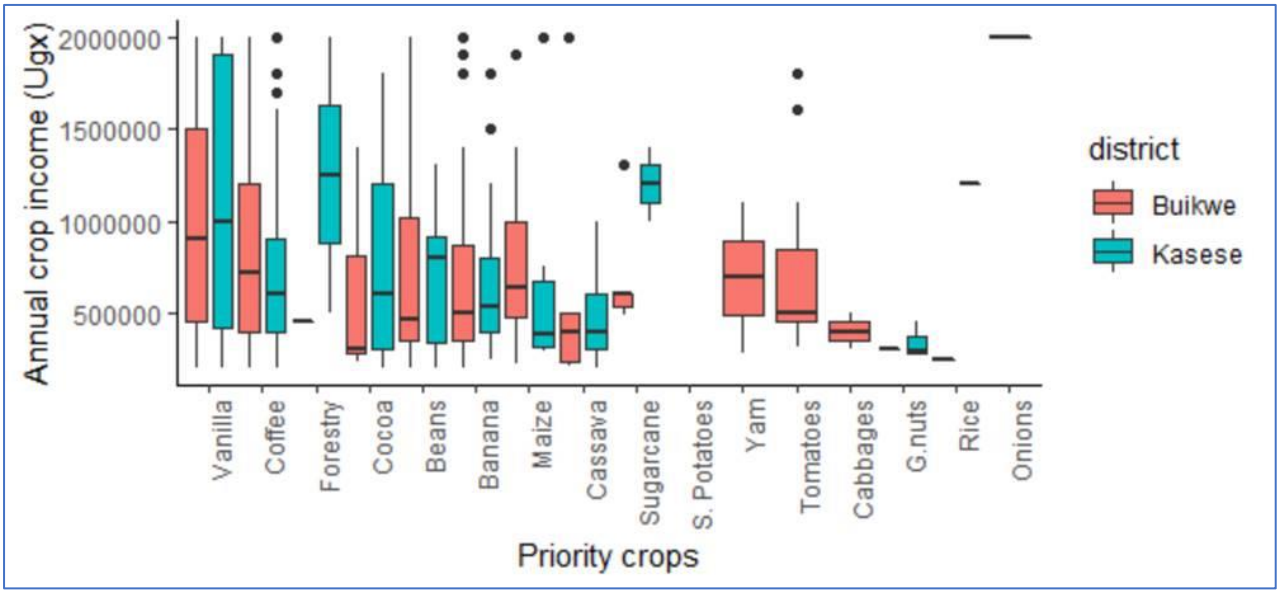


Figure 10: Box plot showing distribution of incomes from the different crops

5.9 Vanilla Production Challenges

A high number of households in both districts report theft as a key challenge for vanilla production: 34% in Kasese and 36% in Buikwe (Fig. 11). Farmers experience theft from the vines to the beans. In other words, both mature and premature beans are stolen. The tutors that support vanilla vines are also stolen when they have just been planted. Pests and diseases are the second most important challenge. The farmers cannot name them when asked to give an example but they recognize them as challenges. Many of those interviewed linked flower abortion to pests and diseases but FDG discussions showed that this was because fertilization did not take place, especially when pollination is done at the wrong time. Lack of readily available extension information on vanilla production is among the highest challenges - the evidence of this is the farmers' inability to identify pests and diseases affecting their crop. Vanilla farmers were found to have very little information, and very few sources of information, relying mainly on farmer-to-farmer engagement only. It was also noted that vanilla is a delicate crop in terms of handling - the flowers at pollination and pods must be handled with the utmost care. Drought retards yields as pollination is less successful in very dry conditions. In addition, flowering is limited in such conditions. Other challenges were identified, such as price volatility, limited research, inadequate markets, and extension.

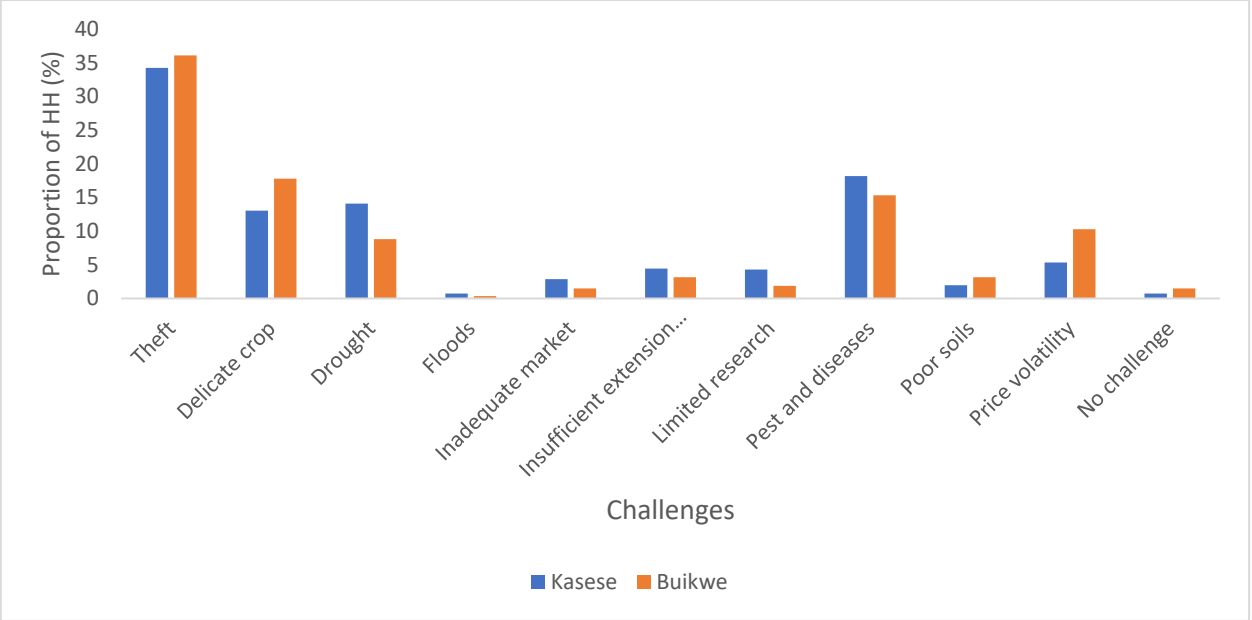


Figure 11: Challenges faced by farmers in the production of vanilla.

6 Coffee Production Challenges

Coffee production was found to face several challenges with the most significant problem being cited as pests and diseases (34.5% in Kasese and 44.7% in Buikwe). Other challenges reported included low prices, drought, inadequate markets, and theft with 23.4%, 21.6%, 9.1% and 8.9% for Kasese and 30.5%, 13.3%, 8.1% and 2.0% for Buikwe respectively (Fig. 12). Drought is a key challenge represented by 21.6% of respondents in Kasese and 13.3% in Buikwe. For coffee, information access was not considered as high a challenge as in vanilla.

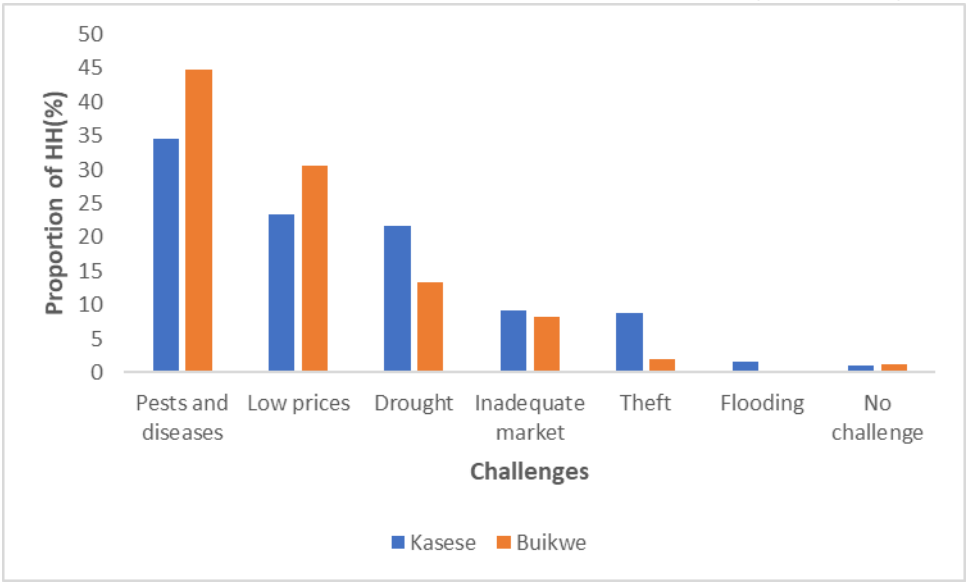


Figure 12: Challenges faced by farmers in the production of coffee.

5.4 .8 Climate Smart Agriculture (CSA) Practices

The common CSA practices for the 2 districts are mulching and trenches (Fig. 13). Cover cropping is practiced to a lesser extent. Terracing is common for Kasese because of its terrain; crop rotation and manure application are applied only in Buikwe. Crop rotation is not applied in Kasese due to land fragmentation resulting from a high population density and farmers practice intercropping on the same piece of land for a long time. On the contrary, farmers in Buikwe obtain some compost manure from Sekalala Enterprises of UVAN (which is offset against vanilla purchases), hence the evident manure compost use in Buikwe. The common cover crops are sweet potato and pumpkin Legume cover crops that add nutrients to the soil are not common, except for beans. Many farmers have not embraced CSA practices due to the limited extension information and support on how and when to apply specific practices.

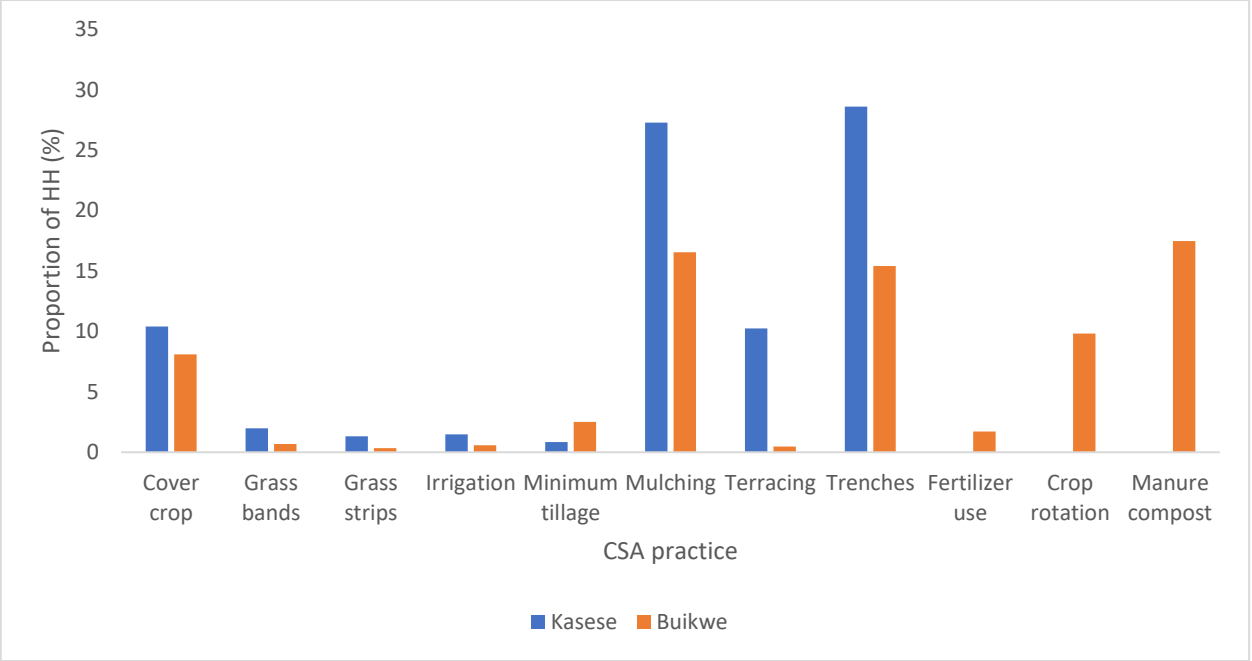


Figure 13: Climate smart agriculture practices undertaken by farmers in Kasese and Buikwe districts.

5.5. Kasese and Buikwe District Land Use

5.5.1 Land use in Kasese district

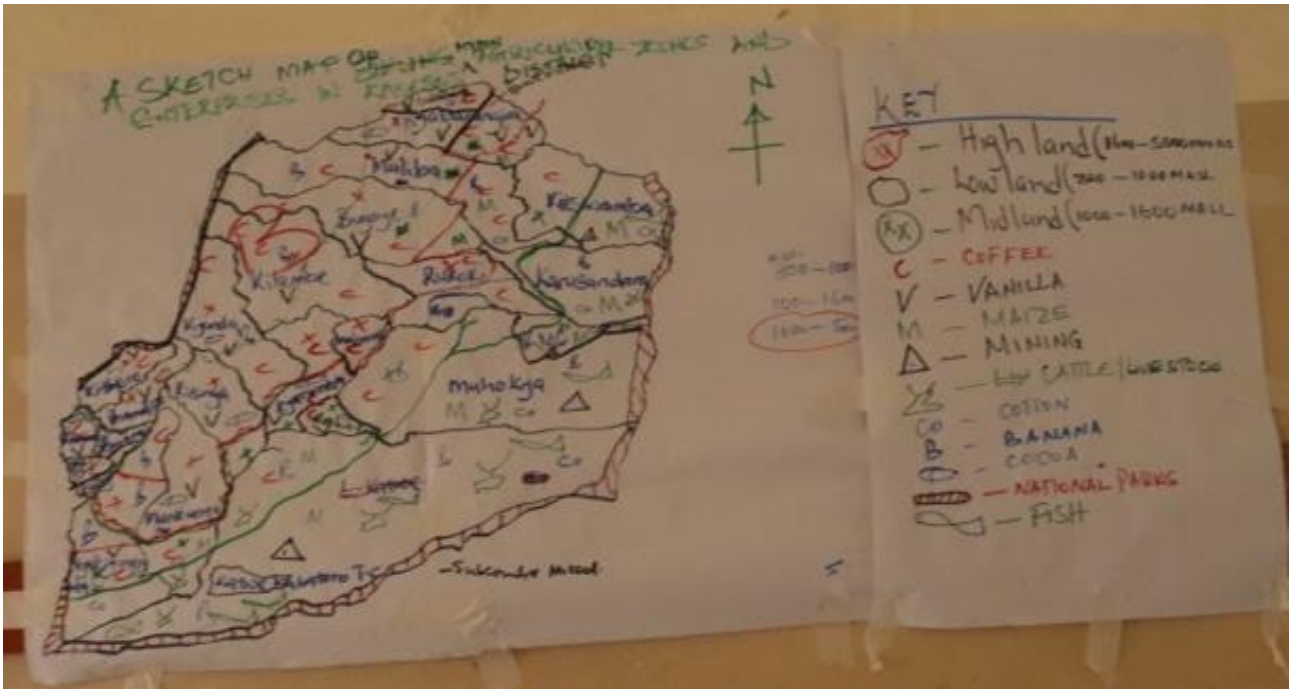


Figure 14: A sketch map of Kasese district land use map developed by Stakeholders

Stakeholder interaction in Kasese district shows the land is divided according to altitude into lowland, midland, and highland (Fig. 14) and that these divisions determine the kind of activities carried out in the different altitudes. The lowland is mainly for fishing, cattle keeping, and mining. The midland is mainly for coffee production, scattered cattle keeping, and some vanilla growing. The highland is used mainly for coffee, banana, and vanilla production. The district is largely surrounded by national parks in the eastern and western parts.

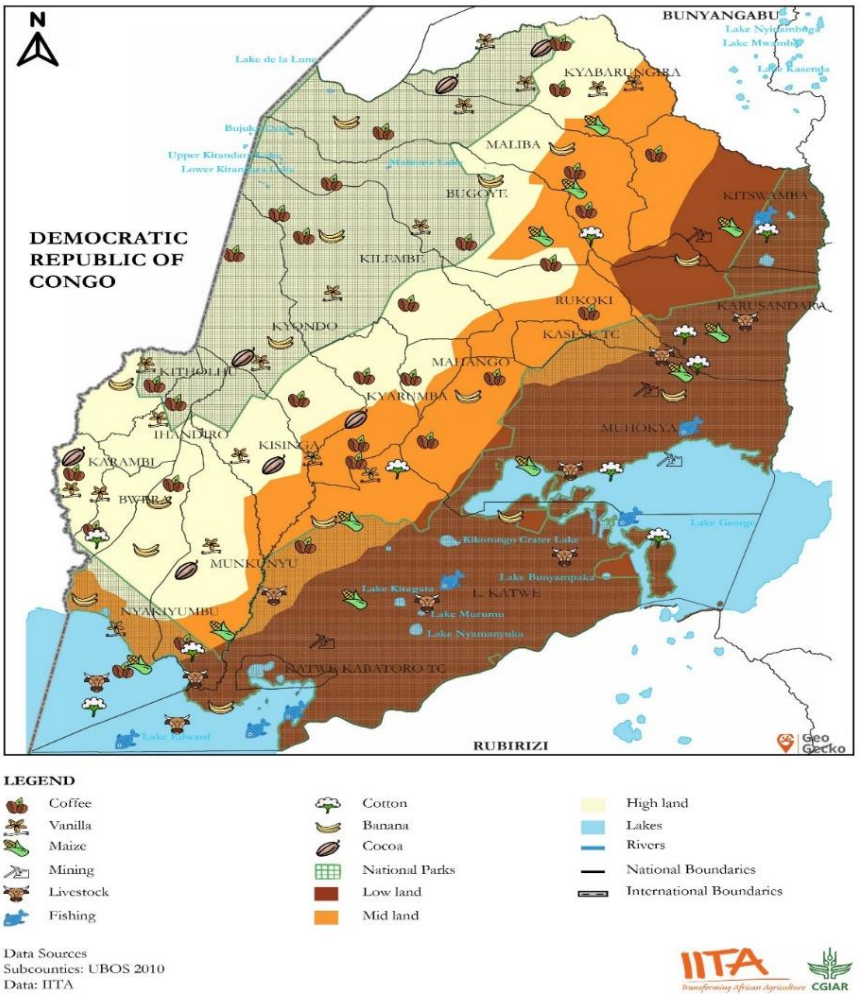
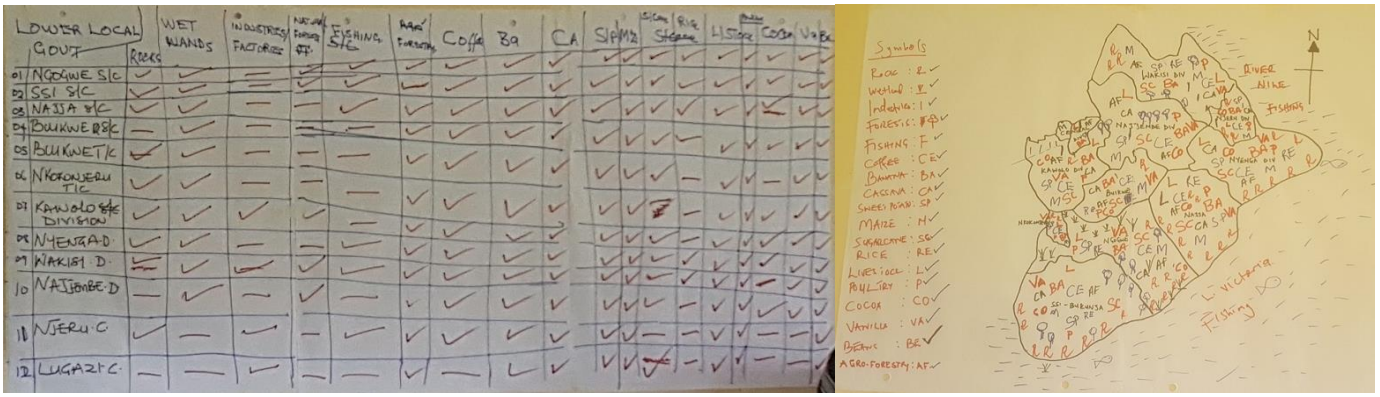


Figure 15: A digitized land use map of Kasese.

5.5.2 Land Use in Buikwe district

In Buikwe, there are different natural resources, industries, fishing, and agro-forestry activities and various crops grown by farmers in almost all the sub-counties in the district. Figure 16 shows how the farmers identified the various natural resources, crops, and economic activities that exist in the various sub-counties represented with symbols. Fishing is done in Lake Victoria and the River Nile. The district also has a good distribution of wetlands and rocks.



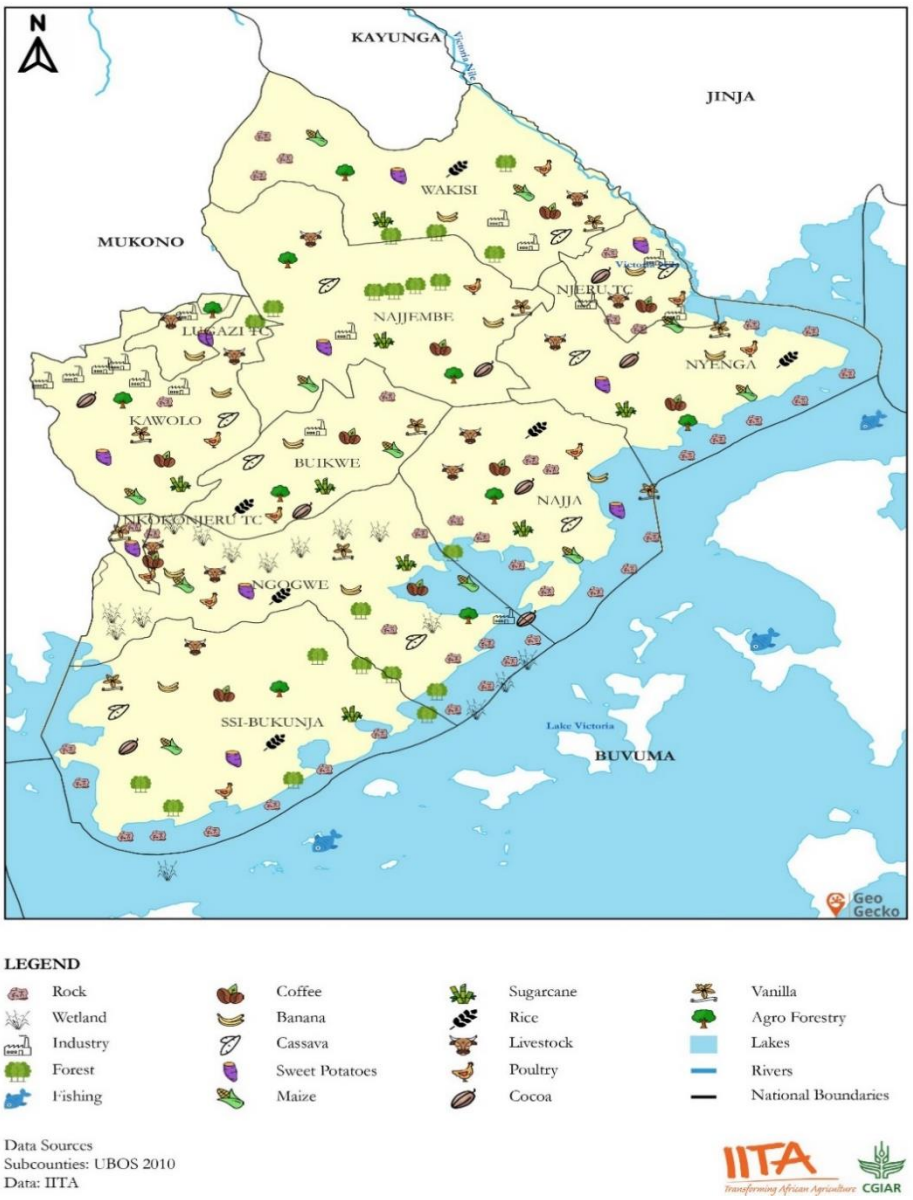


Figure 16: A sketch and digitized land use of Buikwe district for the 12 sub counties

5.5.3 Key Actors in the Value Chain

The main actors in the two value chains are the farmers' groups, cooperatives, and marketing agencies. Cooperatives were more reported by households in Kasese (50%) and farmers' groups were most reported in Buikwe (40%). The marketing agencies interface more with farmers from Buikwe (25%) than from Kasese where the common cooperatives reported were RFCU and Bukonzo Organics. The marketing agencies identified were Kawacom, Esco, and Ndali in Kasese while UVAN, UGACOF, Nucafé and Uganda Industries were some of the identified marketing agencies in Buikwe. Other companies identified were Kiima Foods in Kasese and Bucadef, and Slow foods in Buikwe. NGOs mentioned were Caritas and World Vision. For the government agencies, these were mainly the district and the MAAIF programs such as NAADS and OWC.

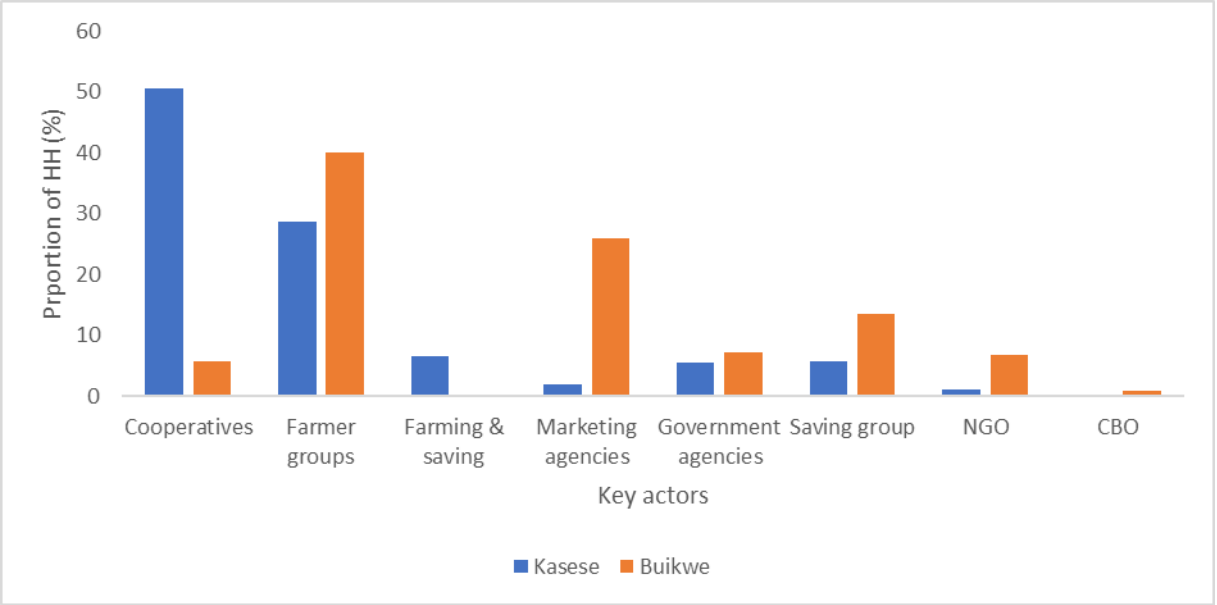


Figure 17: Key actors in the coffee and vanilla value chain.

5.8 Planting Materials Source

Results from the study indicate that farmer-to-farmer exchange is the main source of vanilla planting material in both Buikwe (80.7%) and Kasese (78.2%). However, in Buikwe fellow farmers were recorded as 40.6% and the District Agriculture Office at 35.7%. In contrast, in Kasese coffee planting materials are acquired mainly from the fellow farmers (34.3%), nurseries (27.9%), and organizations (24.3%). In general, there is a limited number of actors in the vanilla seed sector. Compared to coffee, the seed sector is relatively more informal and attracts the participation of fewer actors.

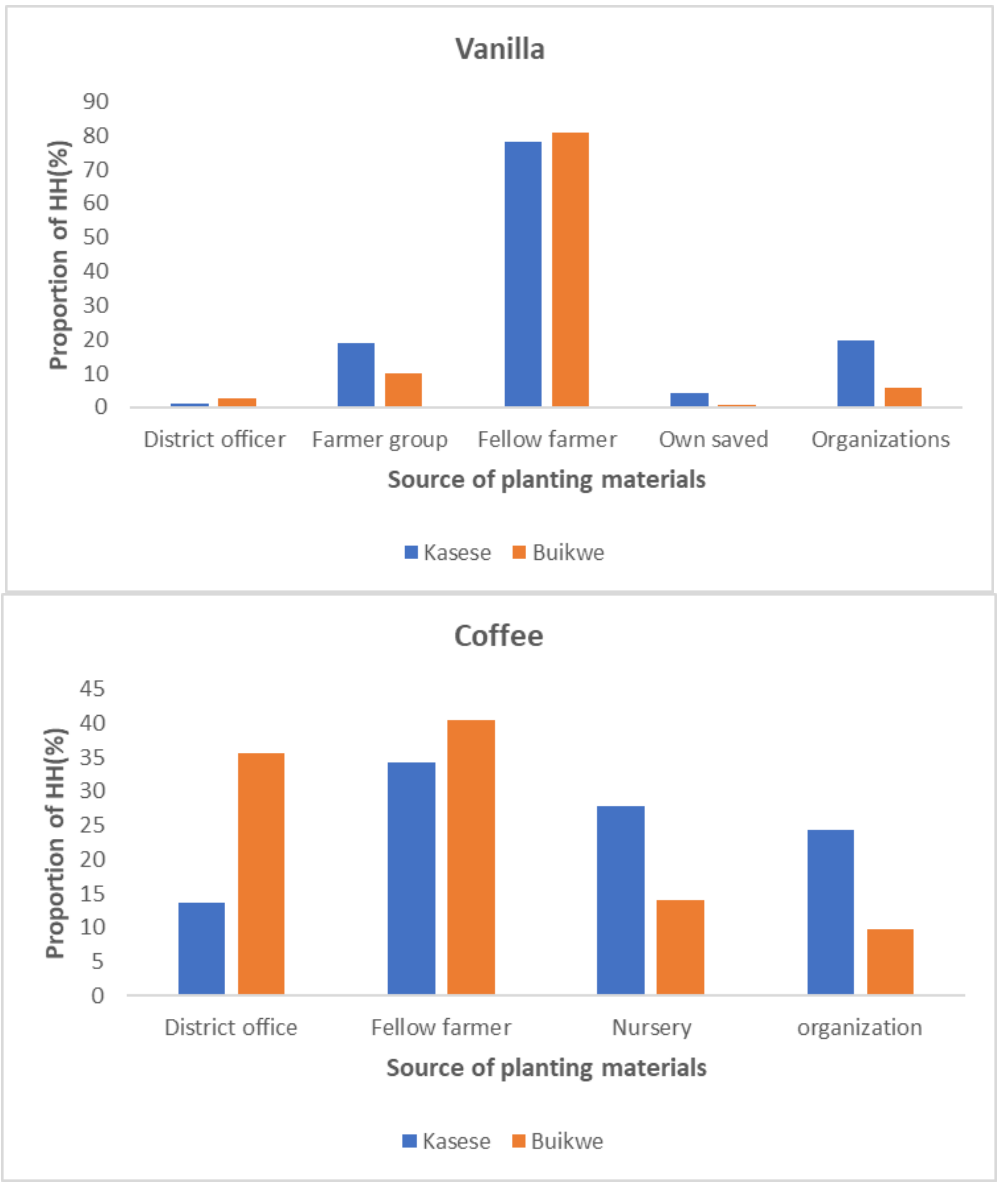


Figure 18: Source of planting materials for coffee and vanilla value chain.

5.9 Sources of Extension Materials

The main source of extension materials and information for vanilla in Buikwe was reportedly from fellow farmers (33.2%), radio (24.2%), and other organizations (20.6%). In Kasese the main source of extension materials and information for vanilla was from organizations (20%), fellow farmers (19%), radio (16.2%), trainings (15.4%), and farmer groups (12.9%).

For the coffee value chain, the dominant sources of extension materials and information for Buikwe were the fellow farmers (28.8%), radios (24.3%), trainings (13.1%), and organizations (12.4%). For Kasese, the major sources of extension materials were also the fellow farmers (22.5%), farmers' groups (21.2%), and organizations (20.8%).

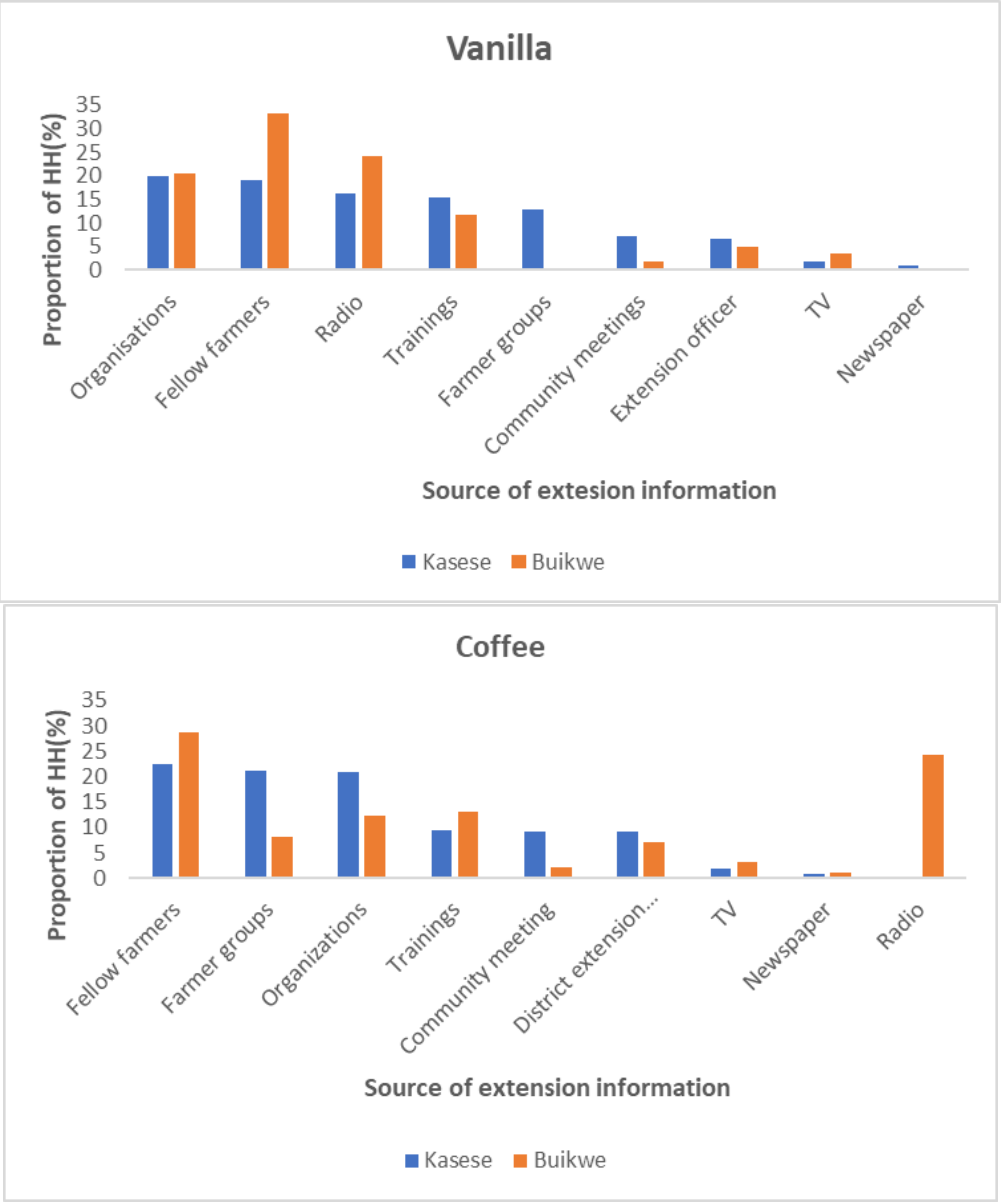


Figure 19: Source of extension information/materials.

6 Findings Shared

A stakeholders' workshop was held on 19 February in Kampala to bring together a selection of participants taking part in the study. In attendance were farmer representatives, Kasese and Buikwe district local government staff, CRS representatives, and IITA researchers. The objective of the workshop was to share the outcome of the study and obtain feedback into a final set of recommendations to be made.

7 Recommendations for Private Sector Investment

	Findings	Mitigation	Recommendation for potential private sector investment
1	Theft, poor coffee quality - lack of traceability; use of fertilizer may affect organic origin for vanilla	Establish / strengthen industry frameworks / harmonization / regulation - reliable source of quality	Engage in PPP dialogue on the development of a robust Vanilla policy and regulatory environment at the National level (National Coffee and Vanilla Platforms) and at the district level (establishment of district level PPP platforms / collaboration and learning alliances).
2	Limited up to date information / knowledge for farmers and stakeholders on	Conduct further research and disseminate results quickly and in easily accessible formats	(1) Conduct cost: benefit analysis and living income study to assess the value of coffee and vanilla diversification for smallholder farmers. (2) Explore use of fertilizers and potential effect on organic vanilla production; (3) Explore

	diversification methodologies		organic or natural methods of crop diseases and pests control
3	Limited adoption by farmers of GAPs and CSA practices	Conduct farmer training in relevant GAPs and CSA practices	Support the piloting of site-specific Stepwise for coffee and vanilla diversified systems, the outputs of which will not only promote adoption of GAPs and CSA but will also present a clear return on investment pathway for scaling.
4	Lack of quality planting materials	Formalize vanilla vine production seed system reproduction and multiplication / dissemination	Support local capacity building of district level seed multipliers to provide quality planting materials and GAPS and CSA practice information and learning for smallholder farmers.
5	Lack of access to financial services, bulking, and marketing facilities	Establishment or strengthening of existing farmers' groups and cooperatives to promote consistent, relevant, and unified services, inputs, and market linkages	Investment in the establishment and / or strengthening of effectively structured / governed organized farmers' groups and cooperatives.
6	Only green beans sold – no added value	Increase value-added activities at the farmers' group / cooperative level	Further exploration of the potential to increase added value by solar drying and curing at the PO level.
7	High cost of, or limited labor for weeding and hand pollination	Establish affordable, safe, and quality local service provision	Support the establishment of youth and women's groups for service provision, creating jobs, and providing consistent labor provision.

8 Conclusion

Studies around the world show that crop diversification leads to increased productivity and stabilizes incomes of smallholder farmers. In sub-Saharan Africa, crop diversification features prominently in many countries' adaptation strategies against climate change. Crop diversification has the potential to increase dietary diversity and food availability, thus contributing to improved nutrition. Through crop diversification, farming households can spread production and income risk over a wider range of crops, thus reducing livelihood vulnerability to weather and market shocks. Additionally, crop diversification can produce agronomic benefits in terms of pest management and soil quality, depending on the crop combination in the field. Smallholder farmers in this study were seen to be incentivized to diversify, given the higher income returns that mitigate market shocks.

As we consider diversified crop systems we move into the area of living income where various other opportunities for increased income sources can be explored: off-farm activities such as *boda-boda* taxi services, sale of labor, and other small business opportunities along specific value chains that offer smallholder households Income generation.

Private sector engagement and lobbying for more effective PPP collaboration are essential to ensure harmonized efforts. Effective PPP engagement supports the government's creation of a robust but flexible policy and regulatory environment that supports private sector initiatives, ensures smallholder farmers have access to quality planting materials and inputs, and provides a consistent, and harmonized flow of knowledge and extension support to smallholder farming communities. Continued research and development is essential to support evidence-based decision-making and continuous improvement of technologies that allow for adaptation to an ever-changing environment – both from a perspective of climate change and that of price volatility in local and international markets – to ensure sustainable production of high value export crops, while increasing nutrition and food security and improved livelihoods for the producers.

Working collaboratively the private sector, development partners, academic and research institutes, governments, and local stakeholders can develop flexible, cost-efficient, and sustainable technologies that increase resilience, nutrition, and food security, and the productivity and marketability of high value crops for export.

9 References

Burke R. Johnson, A. J. (2007). Toward a definition of mixed methods research. *Mixed methods research journal*, 112-133.

district, B. (2015). *Buikwe district deveolpment plant 2015-2016.*

District, B. (2016). *Buikwe District Local Government Profile.*

government, K. d. (2016). *District environment action plan.*

Thong Ho, C. W.-N. (2017). Which farming systems are eficient for vietnamese coffee farmers? *Economic analysis and policy*, 13.

UBOS. (2017). *The national population and housing census; area specific profiles series. Buikwe district.*